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Neighbourhood social fragmentation and the mental health of children in poverty

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ABSTRACT

Using data from 7,776 Millennium Cohort Study children in England, we examined the role of neighbourhood social fragmentation in trajectories of emotional/behavioural problems at ages three, five and seven, and in moderating the association of children's emotional/behavioural problems with neighbourhood poverty, family poverty and adverse family events. Allowing for key background characteristics, social fragmentation generally added little to explain child outcomes, but there were fewer conduct problems among children in poor neighbourhoods with less fragmentation. Surprisingly, in less fragmented neighbourhoods poor families tended to feel less safe and more distressed, which was associated with children's conduct problems.

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In Western settings, the majority of the literature on neighbourhood 'effects' on child mental health has focused on the impact of structural factors, particularly 'deprivation' (Leventhal & Brooks-Gunn, 2000). However, a growing number of studies has found that social processes within neighbourhoods, such as social capital, social cohesion and collective efficacy, partially explain the effects of structural factors on child adjustment (Sampson et al., 2002; Sampson et al., 1997; Xue et al., 2005). These processes are more common in areas that are less socially fragmented, such as those with less residential mobility and more ethnic homogeneity. In fragmented areas, resident interactions tend to be fewer and of lower quality (Putnam, 2000; 2007), aspects of social capital, including trust, social norms and reciprocity, are harder to maintain (Fagg et al., 2008), and more people are socially isolated. These features of the social environment can be important for children's development. For example, Social Disorganisation Theory (Wilson, 1987) posits that in less socially cohesive areas neighbours are less likely to contribute to the monitoring and regulation of child and adolescent behaviour, thereby encouraging bad and minimising good behaviour.

There is mixed evidence for an association between neighbourhood social fragmentation (NSF) and health. NSF has been associated with mental health, in both adolescents and adults (Congdon, 2004; Evans et al., 2004; Fagg et al., 2006; 2008; Stafford et al., 2008), but not physical health (Ivory et al., 2012). According to Ivory et al. (2012), NSF is related to mental health because in highly fragmented neighbourhoods there is less informal social control of the vulnerable. This association is even more likely if those with mental illness are selected by factors such as accessible housing or health-care services into fragmented neighbourhoods. Such neighbourhoods tend to be urban (Whitley et al., 1999) but not necessarily deprived (Cohen et al., 2003; Sampson et al., 2002; Xue et al., 2005).

In the UK, researchers (e.g., Stafford et al., 2008) have explored the role of NSF in explaining area differences in individual mental health using Congdon's (1996) Census-based index of fragmentation. This index captures 'anomie' or social isolation through social characteristics of neighbourhoods, including the population turnover and percentage of residents who live alone, are partnered but unmarried and live in private renting. The index was originally developed to explain differences in area suicide rates among Londoners [and more recently in US samples (Congdon, 2011)], and has predicted suicide better than area deprivation measures (Congdon, 1996, 2004; Evans et al., 2004; Smith et al., 2001; Whitley et al., 1999). To our knowledge, it has not been used to predict young children's mental health problems, although the role of related neighbourhood processes (such as social cohesion and collective efficacy) in child mental health has been tested in both UK and US studies. The US evidence for the role of neighbourhood social cohesion in children's emotional/behavioural resilience is equivocal (Aneshensel and Sucoff, 1996; Caughy et al., 2003). However, a large-scale UK study showed that neighbourhood collective efficacy (consisting of social processes such as informal social control, social cohesion and trust) was negatively associated with children's antisocial behaviour at school entry, although only in deprived neighbourhoods (Odgers et al.,

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2009). Building on these findings, we used Congdon's index of neighbourhood social fragmentation to explore its role in young children's emotional/behavioural problems and resilience in England.

1. This study

We tested three hypotheses. The first was that the social fragmentation of a neighbourhood has an independent role, over and above well-known risk factors, in children's trajectories of problem behaviour. The second was that unfragmented neighbourhoods show a weaker relationship between risk factors (family poverty, low neighbourhood income and adverse life events) and child problems (i.e., such neighbourhoods dampen the effects of risk factors or are 'protective'). The third hypothesis was that any such moderation ('protection') can be explained (mediated) by mother's local social ties, perception of area safety and psychological distress.

In other words, we expected that children would have better emotional/behavioural outcomes if the neighbourhood is less socially fragmented, perhaps particularly if they come from families experiencing higher levels of poverty and adversity or low-income neighbourhoods. In unfragmented places, their mothers may feel safer and less isolated, and therefore happier. However, we also considered the opposite hypothesis that at-risk children may have worse outcomes if they live in unfragmented neighbourhoods because their mothers may feel out-of-place, and therefore distressed. Research in both Western and non-Western settings has shown that the mismatch of individuals' characteristics with those of their community may result in feelings of inferiority or lack of belonging (Putnam, 2007), which could jeopardise mental health (Betancourt et al., 2014; Kupersmidt et al., 1995). Maternal mental health is a very strong predictor of child mental health.

2. Method

2.1. Sample

We used data from the Millennium Cohort Study (MCS) (www.cls.ioe.ac.uk/mcs), a longitudinal survey of children born in the UK during 2000–2002. MCS was designed to over-represent areas with high proportions of ethnic minorities in England, areas of high child poverty, and the three smaller UK countries. The MCS sample is disproportionately stratified by country and type of electoral ward[1]. NHS Multi-Centre Ethics Committees granted approval, and parents gave informed consent before interviews took place. Sweeps 1–4 took place when children were around nine months, and three, five and seven years old, respectively. We used data on children and their families in England, participating consistently in Sweeps 2–4 (n=7,842), when emotional/behavioural problems were measured. The analytic sample comprised 7,776 children after dropping 66 cases without emotional and behavioural problem data in any of Sweeps 2–4. Our analytic approach, growth curve modelling, can handle unbalanced data (Raudenbush and Bryk, 2002). Therefore, children with data on problems for just one or two of these occasions contributed to model estimates, albeit less so than those with complete data.

2.2. Measures

The following variables were measured at child ages three, five and seven unless otherwise noted.

Emotional and behavioural problems were measured with the main parent-reported domain scores on three 5-item scales of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997): conduct problems (α=.55–.68 across sweeps), hyperactivity (α=.71–.78) and emotional symptoms (α=.50–.65). Item responses range from 0 to 2. Internal consistency was at acceptable levels, in line with other SDQ research (Stone et al., 2010). We did not include scores for the SDQ peer problems domain, as the peer problems scale has shown weak internal consistency both in MCS and in other child samples (Stone et al., 2010).

Family socio-economic disadvantage (SED) was a time-varying summary of four binary items measuring economic deprivation (Malmberg and Flouri, 2011). This index captures poverty and associated material conditions more broadly than measured income alone. The four items are: overcrowding (>1.5 people per room), not home owner, receipt of means-tested benefits, and income poverty[2].

Family adverse life events (ALE) were measured as the number (out of 11) of potentially stressful life events experienced between consecutive sweeps. The events, based on Tiet et al. (1998) Adverse Life Events Scale, as far as data are available in MCS, are: family member died, negative change in financial situation, new step-parent, sibling left home, child got seriously sick or injured, divorce or separation, family moved, parent lost job, new natural sibling, new stepsibling and maternal depression (currently being treated for or having been diagnosed with depression).

Neighbourhood median income (NMI) was measured for each Lower layer Super Output Area (LSOA)[3] in England with data from Experian, drawn from multiple sources, including the Census, market research and public sector datasets (Experian, 2011). For Sweep 2, the 2004 estimate of NMI was taken, for Sweep 3, that for 2005 (2006 not being available), and for Sweep 4, that for 2008. Due to the positively skewed distribution of NMI, we used its logarithm.

Neighbourhood social fragmentation (NSF, our central variable of interest) was measured following Congdon (1996). Using 2001 Census data on English LSOAs, we created a summary score of standardised percentages of one-person households, households in private rental accommodation, migrants (adult residents who had lived at a different address one year before the Census) and non-married households. We merged the summary score with MCS data using LSOA geography codes. When we used neighbourhood social fragmentation in our models, we also controlled for urban location as social fragmentation is a largely urban phenomenon. Two dummy variables identified those in any *urban area* (i.e., settlements with population > 10,000), and particularly metropolitan *London*, for which Congdon's index was developed. These dummies, and NSF, can change across sweeps if a family moves. We did not, however, account for change in the characteristics of neighbourhoods themselves, as neighbourhoods generally change slowly.

The variables thought to mediate any interaction of NSF and risk factors in child outcomes were mother's weak local social ties and psychological distress. We measured local social ties as both embeddedness in the neighbourhood and perception of safety. Although safety and embeddedness are independent constructs, we allowed perceived safety to capture social ties because of the evidence that people who perceive their neighbourhoods as unsafe tend to be more mistrustful of their neighbours (Ziersch et al., 2005). We therefore took the position (Almedom, 2005) that (perceived) neighbourhood safety is a function of informal social control, social cohesion and trust. In MCS, *weak local social ties* were measured at child's age five with the mother's responses to two questions about the family's

[1] Wards are basic units of UK electoral geography, with average population around 5,000.

[2] Below a poverty line for equivalised net family income at 60% of the national median household income.

[3] LSOAs cover around 1,500 inhabitants, with boundaries drawn to maximise social homogeneity.

Table 1
Model summary

Model	Specification
Model 1	Area stratum[a] + age + age^2[b]
Model 2	Model 1 + socio-economic disadvantage (SED) + SEDxage + SEDxage^2 + adverse life events (ALE) + ALExage + ALExage^2 + neighbourhood median income (NMI) + NMIxage + NMIxage^2
Model 3	Model 2 + covariates[c]
Model 4	Model 3 + neighbourhood social fragmentation (NSF) + NSFxage + NSFxage^2 + urban + London
Model 5	Model 4 + NSFxSED + NSFxSEDxage + NSFxSEDxage^2 + NSFxALE + NSFxALExage + NSFxALExage^2 + NSFxNMI + NSFxNMIxage + NSFxNMIxage^2
Model 6	Model 5 + (same lower super output area) x (perception of low local safety + local social network))
Model 7	Model 6 + maternal psychological distress (MPD) + MPDxage + MPDxage^2

Notes: age was centred at the grand mean of 5.13 years; ' × ' = interaction between variables

[a] England-disadvantaged, England-ethnic, Wales-advantaged, Wales-disadvantaged, Scotland-advantaged, Scotland-disadvantaged, Northern Ireland-advantaged, Northern Ireland-disadvantaged (reference: 'England-advantaged')

[b] non-linear term of age in years

[c] child gender and ethnicity; maternal education and marital status

locality. This was defined as being 'within about a mile or 20 min' walk of home', not necessarily coinciding with LSOA boundaries. One question sought a binary response to 'Are you friends with any other parents who live in this area?' The second asked for a rating on a five-fold scale describing how safe she felt the locality to be, where five was 'very unsafe'. The responses on local safety were correlated positively, though not perfectly ($r = .3$), with the officially reported crime rate published for the LSOA. MCS did not collect comparable parent-reported views on locality in successive sweeps, so we confined our exploration of whether parental perceptions of locality explained our expected interaction effects to those families who did not change LSOA from Sweep 2 to 4. This involved interacting each of the local ties variables with a dummy variable indicating whether the family remained in their LSOA. *Maternal psychological distress* was measured with the summary score of the 6-item Kessler's scale (Kessler et al., 2003). This scale, ranging 0–24, assesses the experience of recent non-specific psychological distress ($\alpha = .86$–$.88$ across sweeps).

The child-level variables were *age*, *gender* and *ethnicity*. The last two were included as controls, along with two parent-level variables: *maternal education* and *marital status*. Maternal education was indicated by whether the mother had a university degree by child's age 7.

2.3. Analytic approach

First, we investigated whether the families in our analytic sample ($n = 7{,}776$) were different from the 66 in the non-analytic sample (i.e., families living in England in all three sweeps but without at least one set of responses on SDQ) on our study variables. Then, we inspected the correlations between family and neighbourhood risk factors, neighbourhood social fragmentation, outcomes and mediators. Finally, we fitted growth curve models with three levels to avoid the underestimation of standard errors in our hierarchical data by having repeated measures (at ages three, five and seven) of problems ('Level 1') nested in children ('Level 2') nested in the areas in which the sample was originally clustered[4] ('Level 3'). Our growth curve models estimated the mean trajectories (i.e., growth) of children's problems from age three to seven, by specifying an independent variable for time (in this study, age in years centred at the grand mean across sweeps (5.13 years)). Importantly, as children may differ from each other in the level of problems at different ages, this approach also captures individual differences in patterns over time and therefore deviations from mean trajectories. At the same time, it captures the 'clustering' of repeated measures of children's psychopathology as an individual child's problems will be correlated across measurement occasions. In this type of growth curve model, both fixed and random growth parameters are specified. The fixed parameters are the intercept (mean problem scores at the average age) and the slope (mean change in scores per annum). The random parameters simultaneously capture the variation in scores between occasions for each child ('between-occasion variance') and between children at the average age ('between-child intercept variance'), as well as the variation in scores' annual growth ('between-child slope variance'). The covariance between the intercept and the slope indicates whether there is a relationship between children's scores around age five and their growth between ages three and seven. All models reflected the stratified sampling design of MCS from pre-2001 wards by including terms for each stratum. It should be noted that controlling for stratification may absorb some of the neighbourhood social fragmentation or area income effects for those families who remained in their original ward type (i.e., disadvantaged, non-disadvantaged or minority ethnic).

The full sequence of models estimated is in Table 1. Model 1 investigated the average levels and growth of problems by regressing them on age in years and its square (to allow for non-linearity in the average trajectories, see below). Model 2 added the risk factors (SED, ALE, NMI), specified to be related to the intercepts and slopes of problems, to examine whether problems at age five and their change over time shifted with the risk factors. Model 3 added the covariates to account for families' selective sorting into neighbourhoods. Model 4 introduced neighbourhood social fragmentation (NSF), as related to the intercepts and slopes of child problems. At this stage we also introduced the two controls for urban location. Model 5 tested our moderation ('buffering') hypothesis by including interaction terms of each risk factor with NSF on both the intercepts and slopes. Models 6–7 tested our hypothesis about the mediation ('unpacking') of our expected moderator ('protection') effects. Model 6 considered the two variables on local ties, if children remained in the same LSOA from age three to seven, as explained above. Model 7 added maternal psychological distress, also specified to predict both the intercepts and slopes of problems. All models were fitted in STATA 12, and all results are available on request.

3. Results

The families in our analytic sample were more advantaged than those in the non-analytic sample (Tables available upon request). Based on the correlations (Table 2), there was evidence

[4] The MCS sampling frame used electoral wards on pre-2001 boundaries.

Table 2
Correlations among the risk, moderator, outcome and mediator variables in the analytic sample.

	SED3	SED5	SED7	ALE3	ALE5	ALE7	NMI3	NMI5	NMI7	NSF3	NSF5	NSF7	C3	C5	C7	H3	H5	H7	E3	E5	E7	Safe	LSN	MPD3	MPD5	MPD7
SED3																										
SED5	.84																									
SED7	.78	.83																								
ALE3	.21	.21	.19																							
ALE5	.16	.19	.18	.24																						
ALE7	.16	.16	.18	.25	.31																					
NMI3	−.42	−.40	−.39	−.08	−.07	−.10																				
NMI5	−.42	−.40	−.40	−.08	−.07	−.10	.91																			
NMI7	−.41	−.40	−.40	−.09	−.09	−.11	.87	.91																		
NSF3	.25	.24	.24	.07	.08	.04	−.24	−.22	−.21																	
NSF5	.26	.26	.26	.06	.04	.04	−.24	−.28	−.25	.87																
NSF7	.26	.27	.27	.07	.05	.03	−.24	−.27	−.28	.82	.94															
C3	.23	.24	.22	.13	.11	.12	−.20	−.20	−.20	.06	.06	.07														
C5	.24	.24	.23	.10	.13	.11	−.16	−.16	−.17	.06	.07	.06	.50													
C7	.23	.23	.22	.09	.12	.15	−.17	−.18	−.17	.06	.06	.06	.44	.59												
H3	.19	.18	.18	.11	.08	.10	−.17	−.17	−.17	.01	.02	.03	.47	.43	.33											
H5	.21	.20	.20	.10	.10	.11	−.16	−.15	−.15	.03	.03	.04	.36	.53	.43	.58										
H7	.19	.18	.17	.08	.09	.11	−.15	−.15	−.15	.02	.02	.03	.34	.43	.55	.50	.67									
E3	.19	.20	.19	.08	.09	.07	−.16	−.15	−.14	.05	.05	.06	.29	.20	.18	.24	.17	.15								
E5	.16	.17	.18	.07	.11	.08	−.13	−.13	−.12	.06	.07	.07	.23	.27	.22	.18	.27	.19	.43							
E7	.17	.19	.18	.08	.12	.14	−.14	−.14	−.13	.07	.06	.05	.24	.27	.37	.19	.23	.29	.36	.50						
Safe	.25	.25	.23	.06	.09	.07	−.23	−.26	−.25	.17	.21	.20	.13	.13	.11	.10	.11	.10	.11	.12	.11					
LSN	.09	.09	.08	.04	.03	.02	−.10	−.10	−.09	.06	.06	.06	.04	.04	.04	.04	.08	.04	.04	.05	.02	.13				
MPD3	.22	.22	.22	.18	.11	.11	−.14	−.13	−.13	.09	.08	.09	.28	.21	.20	.21	.21	.18	.25	.23	.21	.18	.07			
MPD5	.21	.23	.23	.13	.17	.13	−.13	−.12	−.13	.10	.09	.09	.23	.27	.24	.18	.24	.19	.21	.29	.24	.18	.18	.55		
MPD7	.18	.19	.20	.12	.13	.17	−.12	−.11	−.11	.07	.05	.06	.21	.21	.27	.16	.19	.22	.18	.20	.29	.16	.05	.50	.55	

Note: Two-tailed tests. All coefficients, unless not in boldface, are significant at $p < .05$. 3, 5 and 7 refer to child ages. SED=socio-economic disadvantage; ALE=adverse life events; NMI=neighbourhood median income; NSF=neighbourhood social fragmentation; C=conduct problems; H=hyperactivity, E=emotional symptoms; Safe=perception of (low) local safety; LSN=(small) local social network; MPD=maternal psychological distress.

for interrelationships between SED, ALE, NMI, NSF, outcomes and mediators (i.e., social ties and maternal distress), and for the expected covariation of childhood problems.

3.1. Models

In Model 1, conduct problems and hyperactivity dropped annually .52 and .24 points respectively on the SDQ scale. The significant positive age^2 terms for these domain scores (.14 and .08, respectively) implied a deceleration in the fall of conduct problems at older ages and a slight upward curve for hyperactivity. The average trajectory of emotional symptoms increased, but also not consistently over age. Both age and age^2 terms were positive (.03 and .01, respectively), suggesting a slight acceleration of problems near the end of the trajectory. All random effects were statistically significant with more variation between children at central age and within children over time than between wards. In Model 2 (Table 3), children's problems were significantly related to all three risk factors at central age. ALE and NMI were associated with the trajectory of conduct problems, and ALE was related to an increase in children's emotional symptoms over time. All random effects remained significant except for the between-ward variation in emotional symptoms. The addition of covariates (Model 3, not shown) did not attenuate the risk effects identified in Model 2 on any problem domain. The between-ward variation in conduct problems was no longer significant after allowing for our covariates. Neighbourhood social fragmentation (NSF), introduced in Model 4 (not shown) along with the urban and London area dummy variables, resulted in the random effect of ward on hyperactivity becoming non-significant. NSF was not directly related to any problem type. Model 5 (Table 3) showed that NSF moderated the effect of socio-economic disadvantage (SED) on the change in conduct problems (linear and non-linear) and hyperactivity (linear only) over time, as well as the effect of neighbourhood median income on the linear change in conduct problems over time. The significant interaction terms were small, with t values ranging from 1.97 to 2.93.

To unpack these significant interactions, we plotted the predicted trajectories estimated for illustrative cases of high and low risk (at the 90th and 10th percentile, respectively) children living in neighbourhoods of high and low (at the 90th and 10th percentile, respectively) social fragmentation. We plotted these for all significant interactions, namely the interaction between neighbourhood median income (NMI) and NSF on conduct problems over time, and those between SED and NSF on conduct problems and hyperactivity over time. As can be seen in Fig. 1, a child from a low-income but socially unfragmented neighbourhood has fewer conduct problems during the primary school years than his counterpart in a low-income and socially fragmented neighbourhood. The children in high-income neighbourhoods with high and low levels of social fragmentation follow nearly identical trajectories at a lower level of conduct problems. Between ages five and seven, the trajectory of the child in the low-income but not socially fragmented neighbourhood aligns with that of the children in high-income neighbourhoods. Fig. 2 plots hyperactivity. As can be seen, at around age 3, a poor (high SED) child living in a more socially fragmented neighbourhood has less hyperactivity and fewer conduct problems (Fig. 3) than a poor child in a less socially fragmented neighbourhood. As Fig. 2 shows, the poor children decrease in hyperactivity between ages three and five, and the poor child in the more socially fragmented neighbourhood maintains fewer problems than that in a less fragmented place. From age five to seven, the poor child in the more socially fragmented neighbourhood continues to improve, but his counterpart in the less socially fragmented neighbourhood plateaus at a higher level of hyperactivity. Between ages five and seven, the two trajectories of non-poor children's hyperactivity cross each other, and then stay at a fairly similar level.

In models 6–7 (Appendix) we attempted to explain these interactions. Model 6 showed that, for those who remained in their neighbourhoods from age three to age seven, weak local social ties fully attenuated the effect of the interaction between SED and NSF on the change in conduct problems. There was no other evidence for mediation on conduct problems. Although both local ties variables were significantly associated with hyperactivity at central age, only perception of local safety was related to conduct problems. Mother's local social network was not associated with her child's conduct problems at age five. In Model 7, maternal psychological distress did not mediate the interaction between NMI and NSF in the trajectory of conduct problems, or that between SED and NSF in the hyperactivity trajectory. However, mother's psychological distress, which was strongly associated with all problem domains, fully attenuated the effect of local social network on hyperactivity, and partially attenuated the effects of perceived local safety on both conduct problems and hyperactivity. Further analysis (not shown) revealed that, when considered immediately after Model 5, mother's psychological distress, like her perception of local safety, fully explained the effect of the interaction between NSF and SED on child's trajectory of conduct problems.

4. Discussion

Social fragmentation within neighbourhoods is typically seen as adverse for individual well-being (Putnam, 2000; 2007), and one of the processes through which a structure of deprivation impinges on individual well-being. Our study explored the, as yet unexamined, association between child well-being and neighbourhood social fragmentation (NSF) in three hypotheses. Hypothesis 1 was that NSF would be linked to emotional and behavioural problems in children across the social spectrum, as previous research has shown that socio-economic deprivation is distinct from NSF. In our study, indicators of structural deprivation were positively, but not strongly, correlated with social fragmentation. Unexpectedly, we found no statistically significant main effect for NSF, once neighbourhood income and individual circumstances were controlled. This suggests that social fragmentation has, at best, a weak relationship with behavioural and emotional development in mid-childhood. Of course, it is also possible that any impact of neighbourhood social fragmentation is absorbed by other variables measuring neighbourhood conditions. However, even without controls, we found that correlations of NSF with child outcomes were generally weak. The apparently null finding is consistent with much other research which finds it difficult to identify independent ‘neighbourhood effects’ (van Ham et al., 2012). However, no statistical evidence of an association is not quite evidence for no effect.

Hypothesis 2 was that high fragmentation would be particularly adverse for disadvantaged children, while low fragmentation would be protective. We did find that low NSF had the expected ‘protective’, though small, association with conduct problems for older children in low-income neighbourhoods. Counterintuitively, higher social fragmentation seemed to dampen any ‘effect’ of family poverty on conduct and hyperactivity problems. This implies that social fragmentation, rather than its absence, might be protective under certain circumstances.

On Hypothesis 3, the lower conduct problems of children in less fragmented, low-income areas were not apparently explained (‘mediated’) by mothers' local social ties or depression. However, mothers' local ties and depression explained the counterintuitive association between family socio-economic disadvantage,

Table 3
Fixed effects estimates (unstandardised regression coefficients and standard errors) and variance covariance estimates of problem trajectories (Models 2 and 5).

Predictors	Conduct problems		Hyperactivity		Emotional symptoms	
	Model 2	**Model 5**	**Model 2**	**Model 5**	**Model 2**	**Model 5**
	Coeff.(SE)	Coeff.(SE)	Coeff.(SE)	Coeff.(SE)	Coeff.(SE)	Coeff.(SE)
Fixed effects						
Age	−2.268***(0.243)	−2.349***(0.248)	−0.582(0.309)	−0.730*(0.315)	−0.122(0.238)	−0.131(0.243)
Age^2	0.791***(0.119)	0.789***(0.122)	0.371*(0.159)	0.360*(0.163)	0.138(0.127)	0.109(0.131)
SED	0.197***(0.017)	0.164***(0.018)	0.206***(0.023)	0.152***(0.024)	0.133***(0.017)	0.116***(0.018)
SEDxage	−0.012(0.008)	−0.020*(0.008)	0.002(0.010)	0.004(0.010)	−0.008(0.008)	−0.011(0.008)
SEDxage^2	0.004(0.004)	0.008*(0.004)	−0.005(0.005)	−0.002(0.005)	0.006(0.004)	0.010(0.004)
ALE	0.094***(0.014)	0.088*(0.014)	0.100***(0.019)	0.092***(0.018)	0.074***(0.014)	0.073***(0.014)
ALExage	−0.021**(0.008)	−0.021**(0.008)	−0.007(0.010)	−0.007(0.010)	0.024**(0.007)	0.023**(0.007)
ALExage^2	0.011**(0.004)	0.011**(0.004)	0.001(0.005)	0.001(0.005)	0.004(0.004)	0.004(0.004)
NMI	−0.345***(0.058)	−0.192**(0.063)	−0.448***(0.081)	−0.247**(0.087)	−0.279***(0.055)	−0.203**(0.061)
NMIxage	0.179***(0.024)	0.187***(0.024)	0.036(0.030)	0.051(0.031)	0.013(0.023)	0.014(0.024)
NMIxage^2	−0.066***(0.012)	−0.066***(0.012)	−0.028(0.016)	−0.027(0.016)	−0.013(0.013)	−0.010(0.013)
Girl		−0.290***(0.029)		−0.673***(0.045)		0.020(0.028)
Child ethnicity *(ref: white)*						
Mixed		−0.014(0.080)		−0.003(0.123)		0.035(0.078)
Indian		0.027(0.090)		0.169(0.139)		0.232**(0.089)
Pakistani/Bangladeshi		−0.029(0.072)		0.380**(0.112)		0.580***(0.070)
Black		−0.324***(0.088)		−0.376**(0.135)		−0.113(0.087)
Other		−0.075(0.120)		0.114(0.185)		0.450***(0.119)
Mother has University degree		−0.302***(0.041)		−0.723***(0.062)		−0.134**(0.039)
Married parents		−0.195***(0.030)		−0.265***(0.043)		−0.068*(0.030)
NSF		0.304(0.172)		−0.006(0.232)		−0.159(0.165)
NSFxage		0.158(0.077)		0.143(0.098)		−0.072(0.076)
NSFxage^2		−0.037(0.037)		0.007(0.050)		0.088*(0.040)
Urban area		0.064(0.041)		0.037(0.062)		0.021(0.040)
London		−0.047(0.053)		−0.037(0.081)		−0.030(0.050)
SEDxNSF		−0.006(0.006)		−0.004(0.008)		0.003(0.006)
SEDxNSFxage		0.006*(0.003)		−0.007*(0.003)		0.004(0.003)
SEDxNSFxage^2		−0.004**(0.001)		−0.001(0.002)		−0.004**(0.001)
ALExNSF		0.001(0.005)		0.008(0.006)		−0.001(0.005)
ALExNSFxage		−0.002(0.003)		0.002(0.003)		−0.005(0.002)
ALExNSFxage^2		0.001(0.001)		−0.001(0.002)		0.001(0.001)
NMIxNSF		−0.029(0.017)		−0.001(0.023)		0.016(0.016)
NMIxNSFxage		−0.015*(0.007)		−0.013(0.010)		0.008(0.007)
NMIxNSFxage^2		0.004(0.004)		−0.001(0.005)		−0.009*(0.004)
Area stratum *(ref.=England-advantaged)*						
England-disadvantaged	0.158***(0.040)	0.141***(0.039)		0.127*(0.062)	0.072(0.037)	0.053(0.035)
England-ethnic	0.019(0.055)	0.103(0.064)		0.151(0.102)	0.330***(0.051)	0.128*(0.060)
Wales-disadvantaged	−0.347(0.347)	−0.177(0.342)		−0.317(0.525)	−0.327(0.335)	−0.262(0.333)
Wales-advantaged	−0.244(0.267)	−0.212(0.263)		0.520(0.398)	−0.037(0.252)	−0.039(0.250)
Scotland-disadvantaged	0.030(0.397)	0.046(0.391)		0.420(0.586)	−0.536(0.369)	−0.555(0.366)
Scotland-advantaged	0.627(0.580)	0.548(0.573)		−0.281(0.868)	−0.701(0.551)	−0.674(0.548)
Northern Ireland-disadvantaged	−1.557(1.308)	−1.401(1.292)		−2.453(1.907)	−1.317(1.192)	−1.326(1.184)
Northern Ireland-advantaged	−0.261(0.654)	-0.220(0.645)		−0.331(0.958)	−0.266(0.601)	−0.241(0.597)
Constant	4.872***(0.595)	3.669***(0.649)	7.514***(0.829)	6.185***(0.893)	3.894***(0.563)	3.186***(0.621)
Random effects						
Level 3 (ward)						
Intercept	0.012(0.006)	0.005(0.005)	0.054(0.015)	0.023(0.012)	0.006(0.004)	0.000(0.000)
Level 2 (child)						
Intercept	1.607(0.036)	1.573(0.035)	3.138(0.068)	2.957(0.065)	0.977(0.028)	0.966(0.027)
Slope	0.094(0.005)	0.094(0.005)	0.115(0.008)	0.114(0.007)	0.053(0.005)	0.052(0.005)
Covariance	−0.217(0.009)	−0.218(0.009)	0.044(0.014)	0.039(0.014)	0.086(0.007)	0.087(0.007)
Level 1 (occasion)						
Intercept	1.067(0.020)	1.062(0.019)	1.912(0.035)	1.905(0.035)	1.274(0.023)	1.272(0.023)

SED=socio-economic disadvantage; ALE=adverse life events; NMI=neighbourhood median income; NSF=neighbourhood social fragmentation.

* $p < .05$
** $p < .01$
*** $p < .001$.

neighbourhood social fragmentation and children's acting-out behaviour: poor mothers in less socially fragmented neighbourhoods were apparently more distressed and felt less safe, and their children showed more acting-out behaviour. It may be that the kind of diverse, cosmopolitan areas, often characterised by social fragmentation, provide a more tolerant environment for the most disadvantaged families. Conversely, poor families in less fragmented neighbourhoods may lack a sense of belonging. Their inability to participate in the social networks of their community may be the result of fewer resources (psychological, social and even cultural), related to socio-economic disadvantage. The idea that it may be detrimental to have neighbours who are unlike you echoes research on ethnic diversity/composition, trust and social capital (Putnam, 2007). For example, Sullivan (2010), using MCS data, found that a high proportion of white residents in an area went with reduced social capital among non-white mothers. It is also possible that

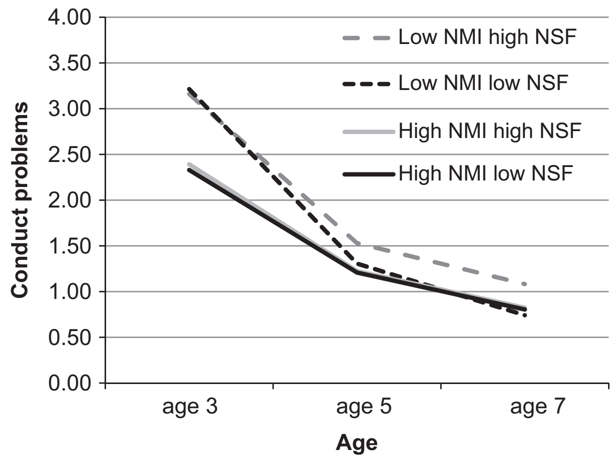

Fig. 1. Predicted conduct problem trajectories (Model 5) by high/low neighbourhood median income (NMI) and high/low neighbourhood social fragmentation (NSF). Low and high values at the 10th and 90th percentiles. Predictions are plotted for boys in urban 'advantaged' areas with University-educated mothers, and otherwise the reference group for each categorical variable, and at the mean of each continuous variable.

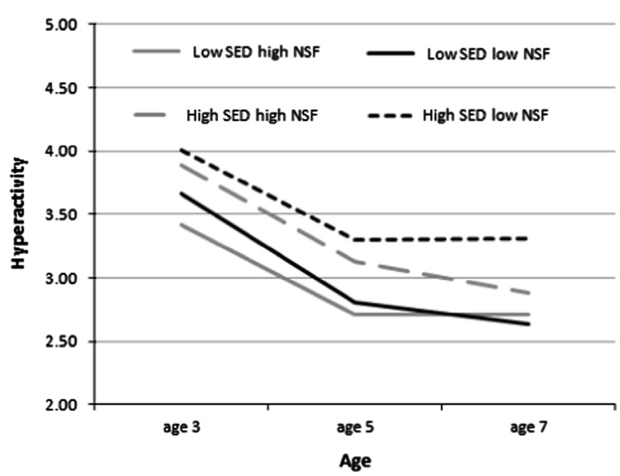

Fig. 2. Predicted hyperactivity trajectories (Model 5) by high/low family socio-economic disadvantage (SED) and high/low neighbourhood social fragmentation (NSF). See also note to Fig. 1.

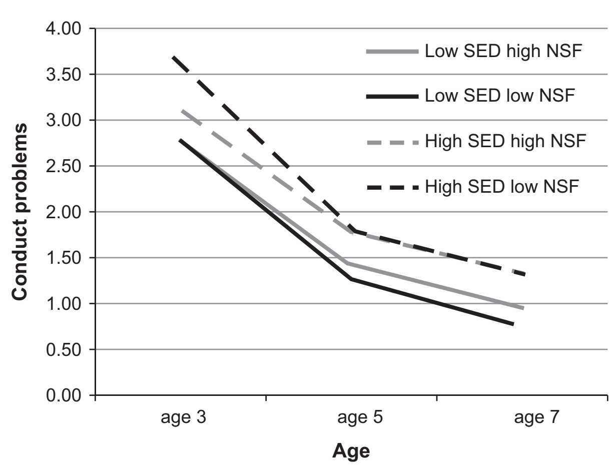

Fig. 3. Predicted conduct problem trajectories (Model 5) by high/low family socio-economic disadvantage (SED) and high/low neighbourhood social fragmentation (NSF). See also note to Fig. 1.

there are other unobserved processes at work, which could involve schools or peer relationships.

The study has some limitations. First, with only three time-points of longitudinal data on emotional/behavioural problems available at the time of writing, there were limits to the functional forms that could be modelled. Second, the reliance on the mother's reports of her mental health, perceptions of her locality and her child's emotional/behavioural problems means that correlations between these measures are likely inflated by shared respondent variance. Third, Congdon's measure is not particularly focussed on families with young children. It captures structural characteristics of neighbourhoods related to cohesion among adult residents, but omits important aspects of the social environment that could be better acquired through residents' reports. On the other hand, by using Congdon's measure, we did avoid having mothers report on both neighbourhood qualities and child adjustment.

In conclusion, this study suggests that any effect of neighbourhood social fragmentation on child behaviour is likely to be weak. The associations we did find depended on the type (family or neighbourhood) of disadvantage. Low fragmentation appeared to have a protective effect on children living in poor neighbourhoods. However, poor families in the least fragmented neighbourhoods felt relatively distressed and unsafe, suggesting negative impact, significant though small, on their children. In this respect, our study is in line with other research showing that the relationship between social capital and child mental health is not straightforward. For example, Caughy et al. (2003) examined 200 African-American families with young children residing in 39 Baltimore neighbourhoods. They found that for children living in poor areas, having a mother with low community attachment was associated with lower levels of behavioural and mental health problems, whereas for children living in more affluent areas, having a mother with low levels of community attachment was related to higher rates of such problems. That well-cited study is one of the many showing that the relation between social capital and health or behaviour outcomes is not straightforward, but did not offer any explanations for this pattern of results. Others (Almedom, 2005; Kawachi and Berkman, 2001) suggest that it may be because social cohesion in the context of poverty and structural disadvantage poses mental health risks to women either because in such contexts they tend to be giving more than receiving, or because they may be constrained by the norms and expectations of their social ties. Our study showed a similarly complex picture among children, and suggested possible reasons for this complexity for future investigation.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.healthplace.2014.11.009.

References

Almedom, A.M., 2005. Social capital and mental health: an interdisciplinary review of primary evidence. Soc. Sci. Med. *61*, 943–964.

Aneshensel, C.S., Sucoff, C.A., 1996. The neighborhood context of adolescent mental health. J. Health Soc. Behav. 37, 293–310.

Betancourt, T.S., McBain, R., Newnham, E.A., Brennan, R.T., 2014. Context matters: community characteristics and mental health among war-affected youth in sierra leone. J. Child Psychol. Psyc. 55, 217–226.

Caughy, M.O.B., O'Campo, P.J., Muntaner, C., 2003. When being alone might be better: neighborhood poverty, social capital, and child mental health. Soc. Sci. Med. *57*, 227–237.
Cohen, D.A., Farley, T.A., Mason, K., 2003. Why is poverty unhealthy? Social and physical mediators. Soc. Sci. Med. *57*, 1631–1641.
Congdon, P., 1996. Suicide and parasuicide in London: a small-area study. Urban Stud. *33*, 137–158.
Congdon, P., 2004. A multivariate model for spatio-temporal health outcomes with an application to suicide mortality. Geogr. Anal. *36*, 234–258.
Congdon, P., 2011. The spatial pattern of suicide in the US in relation to deprivation, fragmentation and rurality. Urban Stud. *48*, 2101–2122.
Evans, J., Middleton, N., Gunnell, D., 2004. Social fragmentation, severe mental illness and suicide. Soc. Psych. Psych. Epid. *39*, 165–170.
Experian., 2011. *Household Income 2011 Data Profile*. Experian Limited, Nottingham, UK.
Fagg, J., Curtis, S., Stansfeld, S., Congdon, P., 2006. Psychological distress among adolescents, and its relationship to individual, family and area characteristics in East London. Soc. Sci. Med. *63*, 636–648.
Fagg, J., Curtis, S., Stansfeld, S.A., Cattell, V., Tupuola, A.M., Arephin, M., 2008. Area social fragmentation, social support for individuals and psychosocial health in young adults: evidence from a national survey in England. Soc. Sci. Med. *66*, 242–254.
Goodman, R., 1997. The Strengths and Difficulties Questionnaire: A research note. J. Child Psychol. Psyc. *38*, 581–586.
Ivory, V., Witten, K., Salmond, C., Lin, E.Y., You, R.Q., Blakely, T., 2012. The New Zealand index of neighbourhood social fragmentation: integrating theory and data. Environ. Plann. A *44*, 972–988.
Kawachi, I., Berkman, L.F., 2001. Social ties and mental health. J. Urban Health *78*, 458–467.
Kessler, R.C., Barker, P.R., Colpe, L.J., Epstein, J.F., Gfroerer, J.C., Hiripi, E., Howes, M.J., Normand, S.-L.T., Manderscheid, R.W., Walters, E.E., Zaslavsky, A.M., 2003. Screening for serious mental illness in the general population. Arch. Gen. Psychiat. 60, 184–189.
Kupersmidt, J.B., Griesler, P.C., DeRosier, M.E., Patterson, C.J., Davis, P.W., 1995. Childhood aggression and peer relations in the context of family and neighborhood factors. Child Dev. *66*, 360–375.
Malmberg, L.E., Flouri, E., 2011. The comparison and interdependence of maternal and paternal influences on young children's behavior and resilience. J. Clin. Child Adol. Psychol. *40*, 434–444.
Odgers, C.L., Moffitt, T.E., Tach, L.M., Sampson, R.J., Taylor, A., Matthews, C.L., Caspi, A., 2009. The protective effects of neighborhood collective efficacy on British children growing up in deprivation: a developmental analysis. Dev. Psychol. *45*, 942–957.
Putnam, R.D., 2000. Bowling Alone: The collapse and revival of American community. Simon & Schuster, New York.
Putnam, R.D., 2007. E pluribus unum: diversity and community in the twenty-first century; the 2006 Johan Skytte Prize Lecture. Scand. Polit. Stud. *30*, 137–174.
Raudenbush, S.W., Bryk, A.S., 2002. Hierarchical linear models: Applications and data analysis methods, *second ed.* Sage, Newbury Park, CA.
Sampson, R., Morenoff, J., Gannon-Rowley, T., 2002. Assessing 'neighborhood effects': social processes and new directions in research. Annu. Rev. Sociol. *28*, 443–478.
Sampson, R.J., Raudenbush, S.W., Earls, F., 1997. Neighborhoods and violent crime: a multilevel study of collective efficacy. Science *277*, 918–924.
Smith, G.D., Whitley, E., Dorling, D., Gunnell, D., 2001. Area based measures of social and economic circumstances: cause specific mortality patterns depend on the choice of index. J. Epidemiol. Commun. H. *55*, 149–150.
Stafford, M., Gimeno, D., Marmot, M.G., 2008. Neighbourhood characteristics and trajectories of health functioning: a multilevel prospective analysis. Eur. J. Public Health *18*, 604–610.
Stone, L.L., Otten, R., Engels, R.M.C.E., Vermulst, A.A., Janssens, J.M.A.M., 2010. Psychometric properties for the parent and teacher version of the strengths and difficulties questionnaire for 4-12 year-olds: a review. Clin. Child Fam. Psychol. Rev. *13*, 254–274.
Sullivan, A., 2010. Ethnicity, community and social capital. In: Hansen, K., Joshi, H., Dex, S. (Eds.), *Children of the 21st Century: The First Five Years.*. Policy Press, Bristol, UK, pp. 33–51.
Tiet, Q.Q., Bird, H.R., Davies, M., Hoven, C., Cohen, P., Jensen, P.S., Goodman, S., 1998. Adverse life events and resilience. J. Am. Acad. Child Psy. *37*, 1191–1200.
van Ham, M., Manley, D., Bailey, N., Simpson, L., Maclennan, D. (Eds.), 2012. Neighbourhood Effects Research: New Perspectives. Springer, Netherlands.
Whitley, E., Gunnell, D., Dorling, D., Smith, G.D., 1999. Ecological study of social fragmentation, poverty, and suicide. Brit. Med. J. *319*, 1034–1037.
Wilson, W.J., 1987. The Declining Significance of Race: The Truly Disadvantaged-the Inner City, the Underclass, and Public Policy. University of Chicago Press, Chicago.
Xue, Y., Leventhal, T., Brooks-Gunn, J., Earls, F., 2005. Neighborhood residence and mental health problems of 5-11 year olds. Arch. Gen. Psychiat. *62*, 554–563.
Ziersch, A.M., Baum, F.E., MacDougall, C., Putland, C., 2005. Neighbourhood life and social capital: the implications for health. Soc. Sci. Med. *60*, 71–86.